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IS 3972-2-3 (1988): Methods of test for vitreous enamelware, Part 2: Test methods, Section 3: Resistance to boiling water and water vapor [CHD 9: Ceramicware]



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Indian Standard

**METHOD OF TEST FOR
VITREOUS ENAMELWARE**

PART 2 TEST METHODS

Section 3 Resistance to Boiling Water and Water Vapour

(*First Revision*)

UDC 662.293 : 620.193.52

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BUREAU OF INDIAN STANDARDS
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AMENDMENT NO. 1 JANUARY 2006
TO
IS 3972 (PART 2/SEC 3): 1988 METHOD OF TEST
FOR VITREOUS ENAMELWARE

PART 2 TEST METHODS

Section 3 Resistance to Boiling Water and Water Vapour

(*First Revision*)

(*Page 1, clause 4.1, line 7*) — Substitute '(*see* IS 1070 : 1992†)' for '(*see* IS : 1070- 1977†)'.

(*Page 1, footnote marked '†'*) — Substitute the following for the existing footnote:

'†Reagent Grade water — Specification (*third revision*).'

(*Page 2, clause 5.1.1*) — Substitute 'See IS 1070 : 1992*' for 'See IS : 1070 - 1977*'

(*Page 2, footnote marked '*'*) — Substitute the following for the existing:

'*Reagent grade water — Specification (*third revision*).'

(*Page 2, clause 5.2.5*) — Substitute 'See IS 2619 : 1993‡' for 'See IS : 2619- 1971‡'

(*Page 2, footnote marked '‡'*) — Substitute the following for the existing:

'‡Glass beakers — Specification (*second revision*).'

(CHD 9)

*Indian Standard***METHOD OF TEST FOR
VITREOUS ENAMELWARE****PART 2 TEST METHODS****Section 3 Resistance to Boiling Water and Water Vapour***(First Revision)***0. FOREWORD**

0.1 This Indian Standard (Part 2/Sec 3) (First Revision) was adopted by the Bureau of Indian Standards on 20 May 1988, after the draft finalized by the Ceramicware Sectional Committee had been approved by the Chemical Division Council.

0.2 The Committee, while reviewing IS : 3972, decided to publish the standard in two parts. Part 1 will deal with production of Specimen (in two sections). Part 2 will deal with various test methods applicable to vitreous enamelled sheet steel and vitreous enamelled cast iron. The Committee also decided that Part 2 shall have various sections and each section would deal with a particular test method. Section 1 and Section 2 covering resistance to citric acid at room temperature and boiling temperature, and low and high voltage test for detecting and locating defects have already been published, while Section 4, Section 5 and Section 6 covering resistance to thermal shock, resistance to hot alkali (sodium hydroxide), and reflectance and specular gloss respectively are under print.

0.3 In this section (Part 2/Sec 3), test method for determining the resistance to boiling water and water vapour has been prescribed. Surface treatment method (hot water) test for water resistance has been deleted and total immersion method (boiling water) test has been modified. Simmering time has been increased from 2½ hours to 2 days or 14 days.

0.4 In the preparation of this standard, assistance has been derived from ISO 2744-1973 Vitreous and porcelain enamels Determination of resistance to boiling water and water vapour, issued by the International Organization for Standardization (ISO).

0.5 In reporting the result of a test or analysis made in accordance with this standard, if the final value observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

*Rules for rounding off numerical values (revised).

1. SCOPE

1.1 This Indian Standard (Part 2/Sec 3) prescribes the methods of test for determining the resistance to boiling water and/or water vapour applicable to vitreous enamelled sheet steel and cast ironwares/flat surfaces.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 2717-1979* shall apply.

3. SAMPLING

3.1 Representative samples of vitreous enamel-

ware shall be drawn as specified in individual material specifications.

4. TEST SPECIMENS

4.1 The specimens of approximately 105 mm diameter shall be prepared in accordance with IS : 3972 (Part 1/Sec 1 and 2)-1982* depending upon the base metal used for enamelling. Each specimen shall be cleaned with a suitable grease solvent such as trichloroethylene or acetone, rinsed with distilled water (see IS : 1070-1977†) until the water spreads evenly on the surface.

*Methods of test for vitreous enamelware: Part 1 Production of specimen for testing. Section 1 Enamelled sheet steel, and Section 2 Enamelled cast iron (first revision).

†Specification for water for general laboratory use (second revision).

*Glossary of terms relating to vitreous enamelware and ceramicware systems (first revision).

Then the specimen shall be dried for 2 hours in the air oven at $110 \pm 2^\circ\text{C}$, cooled for at least 2 hours in the desiccator and weighed to the nearest 0.2 mg.

5. TEST FOR RESISTANCE TO BOILING WATER AND WATER VAPOUR

5.0 Principle — Each set of similarly enamelled specimen is exposed to attack by boiling distilled water for 48 h (2 days) or 336 h (14 days), the specimens being placed in the liquid chamber and in the vapour chamber of the testing apparatus as required. The area exposed to attack should not be less than 50 cm^2 . The loss in mass is determined. The lower the loss in mass, the higher is the resistance of the vitreous enamel to boiling water or water vapour.

5.1 Reagents

5.1.1 Distilled Water - See IS : 1070- 1977*.

5.1.2 Dilute Acetic Acid Solution — 5 percent (mass/mass).

5.2 Apparatus

5.2.1 Testing Apparatus and Packing — Same as prescribed in 6.1.2 of Section 1 of this part of the standard.

5.2.2 Hot-air Oven — capable of maintaining a temperature of at least 130°C .

5.2.3 Desiccator — With an internal diameter of 200 mm.

5.2.4 Graduated Measuring Cylinder — Capacity 500 ml (see IS : 878- 1975†).

5.2.5 Beakers — See IS : 2619 - 1971‡.

5.2.6 Balance — accurate to ??? 0.2 mg.

5.2.7 Sponge Soft.

5.3 Procedure

5.3.1 Fix the specimens in the testing apparatus so that the cover coat sides of the specimens are facing the interior of the cylinder. Screw down the three wing nuts evenly to make the testing apparatus water tight. Run 350 ml of the distilled water into the socket for the return flow cooler, replace the latter and switch on the heater. As soon as the water begins to boil (two to four bubbles per second), lower the current by the rheostat control so that the water simmers during the remainder of the test. Record the temperature during the simmering.

*Specification for water for general laboratory use. (second revision).

†Specification for graduated measuring cylinders (first revision).

‡Specification for glass beakers.

The simmering time shall be 48 h (2 days). If the loss in mass of a specimen after this time is less than 5 mg, carry out the test with new specimens and a simmering time of 336 h (14 days). If the test is confined exclusively or mainly to attack by one phase only (liquid or vapour), this determines the testing time 2 or 14 days respectively. After simmering for 48 h (or 336 h), empty the cylinder and, after cooling, rinse with distilled water. Take the specimen from the testing apparatus and wipe them three times with the sponge and cold dilute acetic acid at room temperature, then rinse with distilled water. After carefully removing any packing residues from the edges of the specimens, dry them for 2 h in the hot-air at $110 \pm 2^\circ\text{C}$. After a further 2 h in the desiccator, weigh them again to the nearest 0.2 mg.

5.3.2 For each determination, two tests with each set of specimens shall be carried out. Specimens not enamelled on both sides shall be used only for the short test period (48 hours).

5.4 Calculations

5.4.1 The loss of mass per unit area of the enamelled surface after treatment with boiling water is calculated as follows:

Loss in mass, grams per square metre per day

$$\text{a) for 2 days} \quad \frac{M_1 - M_2}{A \times 2}$$

$$\text{b) for 14 days} \quad \frac{M_1 - M_2}{A \times 14}$$

where

M_1 = mass in g of the test specimen before test,

M_2 = mass in g of the test specimen after test, and

A = area in square metre of the exposed surface of the test specimen.

5.4.2 The results obtained for the specimens placed in the liquid chamber and in the vapour chamber of the testing apparatus are calculated separately. Since the determination consists of two parallel tests, two values are given for the attack in the liquid phase and two for the vapour phase, which are then averaged. The difference between the minimum and maximum individual values of the loss in mass shall be less than 30 percent; the 30 percent are calculated from the arithmetic mean of the individual values. If not, a further test shall be carried out, the results of which shall be taken into account in calculating a new arithmetic mean.

5.4.3 The results of the specimens which show defects, such as pinholes down to the metal, chipped edges or edge corrosion are omitted. The corresponding number of new specimens shall be tested.

5.5 Test Report

5.5.1 The test report shall include the following

particulars:

- a) testing temperature, in degrees Celsius;
- b) simmering time, in days;
- c) loss in mass for 2 days or 14 days in grams per square metre per day, rounding to the nearest 0.01 g/(m².d), separated according to vapour and liquid phases, giving the arithmetic means and the number of single values.

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